



Cavity sensitivity correction factors for alanine dosimetry in Bruker EMX-micro EPR spectrometers

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Conclusion

Artificial measurements allow us to compare different pre-treatment verification methods in relatively quick way without occupancy of the linac time for measurements. Another benefit from our methodology is that the result is independent of the measurement's uncertainties. Based on artificial measurements comparison we can decide on clinically adequate gamma criteria and percent of passing points levels for different devices and cancer sites.

EP-1793 Establishing local confidence limit and the optimization of VMAT patient specific quality assurance

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Purpose or Objective

Optimization of VMAT patient specific quality assurance (QA) through establishing the institutional local confidence limit by statistical analysis of gamma results.

Material and Methods

The VMAT patient specific plans for fifty VMAT cases were calculated in Varian Eclipse treatment planning system (TPS) and all the plans were executed in Varian Clinac Trilogy machine. Patient specific QA was performed using portal dosimetry (Varian) and Arc check device (Sun nuclear). The gamma criteria of 3% dose difference and 3mm distance to agreement was used to find the difference between TPS calculated and measured dose distribution.

Area gamma, mean gamma and maximum gamma were calculated and tabulated for the TPS vs. measured planar dose using portal dosimetry. The percentage of pixels passing gamma of one was calculated and tabulated for the TPS vs. measured planar dose using Arc check device. The mean and standard deviation of the gamma results were calculated and the local confidence limit was derived by using the concept of $|\text{mean}| \pm 1.96\sigma$

Results

In portal dosimetry, the area gamma ≤ 1 , average gamma and maximum gamma were 99.1 ± 1.06 , 0.26 ± 0.05 and 2.05 ± 0.53 respectively with gamma criteria of 3% dose difference and 3mm distance to agreement. In Arch check, the average percentage of pixels passed the gamma of one was 99.3 ± 0.7 .

Local confidence limit derived for portal dosimetry area gamma, average gamma and maximum gamma were 97%, 0.37 and 3.10 respectively. For Arc check, the confidence limit derived was 98% against the gamma criteria of 3%-3mm.

Conclusion

The local confidence limit for gamma analysis using portal dosimetry and Arc check device was established. Every institution should establish their local confidence limit in order to optimize the patient specific QA based on their machine, QA device and type of plans.

EP-1794 Cavity sensitivity correction factors for alanine dosimetry in Bruker EMX-micro EPR spectrometers

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Purpose or Objective

Alanine is a passive solid-state dosimeter material with potential applications for remote auditing and dosimetry in complex fields or non-reference conditions. Alanine has a highly linear dose response which is essentially independent of dose rate and energy for clinical MV

photon beams. Alanine is available as pellets with a 5 mm diameter, and irradiations in flatten-filter free beams or other non-uniform beams are therefore subject to volume averaging and EPR spectrometer cavity sensitivity correction. In this work, we report on a simple model that can provide volume and cavity sensitivity correction factors for improved output factor measurements in small MV photon beams.

Material and Methods

The x-ray beam was delivered by an Elekta Versa HD linac with an Agility MLC160 radiation head. Symmetric and square field sizes (FS) for 6 MV flattened filter free (FFF) beams were considered. The data were acquired at SSD=90 cm, depth 10 cm. The alanine pellets were the standard Harwell/NPL type ($\varnothing 4.83 \times 2.80$ mm). The pellets were placed in water with a latex sleeve to protect against water. A Bruker EMX-micro EPR spectrometer equipped with an EMX X-band high sensitivity resonator was used to read out the dose deposited in the alanine pellets. The beam profiles were measured using single detectors in a PTW MP3 water tank. A rotational symmetric Gaussian horizontal beam profile and exponential decaying depth dose profile in the vicinity of the pellet was fitted to the measured profiles. Cavity sensitivity correction functions found in literature (Anton et al. 2015) and in the technical manual of the Bruker spectrometer were used.

Results

The fit of the beam profile in three dimensions was based on two parameters: the variance for the Gaussian profile and the gradient of the depth profile. The parameters in turn were both changing as function of FS. Using the fitted beam profiles, an analytical model was developed for the calculation of volume and cavity sensitivity correction factors k_v and k_s for given FS (see Table 1).

Energy FS (cm)	6 MV FFF k_v	6 MV FFF k_s (Anton)	6 MV FFF k_s (Bruker)	6 MV FFF OF \pm SD (Anton)	6 MV FFF OF \pm SD (Anton)	6 MV FFF OF \pm SD (Bruker)
0.8	1.062	0.997	0.983	0.652 ± 0.010	0.652 ± 0.010	0.644 ± 0.010
1.0	1.035	0.996	0.992	0.708 ± 0.011	0.708 ± 0.011	0.704 ± 0.011
1.4	1.012	0.999	0.997	0.785 ± 0.013	0.785 ± 0.013	0.783 ± 0.013
2.0	1.004	1.000	0.999	0.834 ± 0.013	0.834 ± 0.013	0.833 ± 0.013
3.0	1.002	1.000	1.000	0.882 ± 0.012	0.882 ± 0.012	0.882 ± 0.012
4.0	1.001	1.000	1.000	0.913 ± 0.012	0.913 ± 0.012	0.913 ± 0.012
10.0	1.000	1.000	1.000	1.000 ± 0.019	1.000 ± 0.019	1.000 ± 0.019

Table 1: Calculated volume correction factors k_v , sensitivity correction factors k_s (Anton/Bruker), temperature, volume, and sensitivity corrected output factors (OF) with SD being one standard deviation (SD) are displayed for the 6 MV FFF beam as function of the field size FS.

Conclusion

The cavity sensitivity correction was found to influence the alanine measurements in the range of 3 to 17 % for the smallest field size depending on the cavity sensitivity correction function applied. A simple analytical expression for the correction factors as function of field size and the radius of the sensitive volume of the detector was obtained. The method presented here would be applicable for other detector geometries and beam energies. The cavity sensitivity correction was found to be small. The differences in the cavity sensitivity corrections functions (Anton/Bruker) might arise from the method used in detection of the cavity correction function and the applied spectrometer.

EP-1795 Scp measurement of a 5 mm diameter cone using a scanning chamber method.

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